2012
ISSUE 15

INFUSION

coffey
SPECIALIST KNOWLEDGE
EXTRAORDINARY OUTCOMES

Mining Environment
Now Begins at the End

Managing
Art Development

Respecting Respirators

■ Talking Mine Re-entry ■ World Leading Rock Testing ■ Overcoming Road Blocks

managing director's message

With the tyranny of distance in Australia, we rely heavily on our roads for freight movement, making the highway between Melbourne and Brisbane a driver of the country's economic productivity.

As the upgrade of this vital transport link reaches the home stretch, Coffey is extremely proud to have been involved in many of these significant and challenging road projects.

In this edition, we feature our role in the Ballina Bypass Alliance and how the team has overcome incredible engineering and construction challenges to build the bypass on one of the deepest patches of soft soil in Australia. But not just that – to deliver it on budget, six months ahead of schedule is remarkable.

The Ballina Bypass really exemplifies for me the extraordinary results that can be achieved when a collaborative design approach is undertaken. I would like to congratulate everyone in the team for their dedication to achieving a best-for-project outcome.

On page seven, we share some of the learnings from our work on Western Australia's first contaminated site audit for a mine closure and how our clients can benefit from addressing mine closure early in the lifecycle. You may also find the information about amendments to Western Australia's Mining Act useful.

We have also provided a timely reminder about the importance of safety in the workplace at every level and on every occasion. I encourage you to read some of the lessons we have learned recently about the use of personal protective equipment. Please share with your colleagues these practical tips for choosing and using the correct respirators.

Lastly, a big congratulations to everyone who worked on the Auckland Art Gallery Toi o Tamaki, which received the highest honours at the recent Property Council New Zealand Rider Levett Bucknall Property Industry Awards (see over).

John Douglas
Managing Director

MAKING

CEMENTING MAJOR ROADS

Coffey Information has been appointed by Thiess to deliver materials testing and analysis services to the Hunter Expressway Alliance, cementing the business as the leader in construction materials testing in large road infrastructure projects in Australia.

As part of the expected A$6 million project, Coffey Information will provide laboratory testing services, including construction materials conformance and quality control testing, during the construction phase of the eastern section of the Hunter Expressway project.

The RTA formed an alliance with Thiess, Parsons Brinckerhoff and Hyder Consulting to build the eastern section of the Hunter Expressway, which stretches from the F3 Freeway to just east of Kurri Kurri.

MANAGING ART DEVELOPMENT

A multi-million dollar restoration and expansion of the Auckland Art Gallery, Toi o Tamaki, has added an exciting and much-needed addition to New Zealand's home of visual arts.

The development, which was project managed by Coffey Projects, enables the gallery to accept larger exhibitions and display a larger proportion of its vast collection. It has also revived the gallery as a vibrant new focal point within the cultural precinct of the city.

Successfully blending the modern extension with the original heritage building has achieved stunning results, and will provide a memorable experience for visitors to the gallery.

Coffey Projects was contracted from the outset of the project to advise and assist with the development of the project brief and scope of works, as well as being responsible for the appointment and management of design consultants, management of the construction procurement process and completion of the construction and close-out.

The project received the highest honours at the recent Property Council New Zealand Rider Levett Bucknall Property Industry Awards.

NEWS

SCHOLARSHIPS AWARDED

Coffey International Development continues to strengthen its position in scholarship management in the Asia Pacific region. Following from the successful management of the first phase of the Australia Scholarships for Development in Vietnam program, the business has recently been awarded an extension that will see it manage the program through to 2016. The program aims to provide 240 scholarships to Vietnam each year.

Coffey International Development has also been contracted to manage the Indonesia Australia Development Scholarships, which will run for two years. The program offers up to 525 scholarship places at master's and doctoral level for Indonesians from both the public and private sectors. The scholarships contribute to workforce development in Indonesia and build mutually beneficial people-to-people links.

Both projects are funded by AusAID and reinforce the Australian Government's commitment to education in the Asia Pacific region.

MATERIALS TESTING FOR GORGON

Coffey Information has been appointed by Leighton Contractors to deliver materials testing and analysis services to Chevron's Gorgon Civil and Underground Services Project. The contract is expected to be worth approximately A$5 million.

The business will establish a dedicated NATA-accredited construction materials testing laboratory onsite for the project. Services include materials conformance and quality control testing to support the construction phase of the project. The onsite laboratory will be equipped and resourced to test all soils and aggregates used in the construction of this stage of works.

Leighton Contractors commenced work on the civil and underground works package for the Chevron Australia's Gorgon Project in September 2010. The project includes earthworks, in-situ and precast concrete and underground services, including drainage, piping and electrical and instrumentation cabling, which will be installed within the LNG plant site.

WORLD-LEADING ROCK TESTING

Coffey Information now has a world-leading rock testing facility that can help to reduce the risk of error in engineering calculations and projects.

The new laboratory, which is based in Melbourne, offers three unique areas of expertise:

- Measuring the physical and mechanical properties of rocks, for the design of tunnels and mines
- Characterising the abrasiveness of solid and fragmented rocks and soils, as it affects the difficulty of dredging, trenching and soft-ground tunnelling in these materials, and to what extent the machinery will suffer wear
- Characterising rocks in order to predict the performance of rock excavating machinery.

It is one of the few laboratories in the world to have this type of abrasivity testing and analysis for dredging, trenching, mining and soft tunnelling projects. It is also Australia's only lab that provides excavatability characterisation.

Coffey Information's rock-testing capability can be applied to quarries, infrastructure, tunnelling, oil and gas, and mining projects. Samples from any location in the world can be analysed. The results enable clients to achieve a more accurate understanding of the materials, loadings, appropriate excavation methods and timing, geotechnical and design requirements and costs of construction of a project.

Associate Professor Bill Bamford heads the new facility, enabling Coffey Information to not only provide advanced rock testing but also detailed analysis, training and world-leading expertise in rock testing. Bill is currently an honorary Principal Fellow and Associate Professor in the Melbourne School of Engineering at the University of Melbourne.

OVERCOMING **ROAD BLOCKS**

Sophisticated approaches to ground treatment are allowing roads to be built ahead of schedule and in areas where it has not been previously possible. Read how a new highway has been built on one of the deepest patches of soft soil in Australia.

Some incredible engineering and construction challenges have been overcome to not only build the new Ballina Bypass, but to deliver it on budget, six months ahead of schedule.

Coffey Geotechnics principal geotechnical engineer Richard Kelly said the Ballina region in northern New South Wales was a difficult environment for road construction.

“Ballina has some of the most complex geotechnical conditions in Australia, including deep, soft soils in the floodplains area where the water table is close to the coastal floodplains.

“Managing these soft soils was an important consideration in the design, construction and maintenance of the Ballina bypass project.

“On top of this, Ballina is one of the wettest regions in Australia, creating significant challenges for the construction team. The project area also contained two major Pacific Highway black spots, with poor alignment and road shoulder access,” Richard explained.

To deliver this significant project in the Pacific Highway upgrade, NSW Roads and Maritime Services formed an alliance with Leighton Contractors, Coffey Geotechnics, AECOM and SMEC.

“From the outset of the project, the Ballina Bypass Alliance focused on an integrated, collaborative design approach that emphasised best-for-project outcomes.

FAST FACTS

- Construction of three major interchanges at Teven Road, Cumbalum and Ross Lane

"This approach has been integral in overcoming the soft soil challenges, driving the right balance in residual settlement between the construction schedule, pavement and performance, initial capital cost and whole-of-life performance," he said.

The original concept design for the Ballina Bypass adopted conventional staged construction using surcharge and wick drains over a 13-year construction period. "Through the adoption of innovative ground treatment methods and a whole-of-life approach to capital costs and maintenance, the 13-year period was reduced to four years plus two years of early works. The early works were undertaken by RMS and Coffey Geotechnics," he noted.

The Ballina Bypass Alliance took an unusual approach of not adopting a risk-adverse solution that could either take too long to complete the project, or would meet the desired timeframe at a significantly higher cost.

The approach adopted by the alliance involved prioritising the ground treatment in time critical areas and/or areas of road performance risk, balancing capital costs against maintenance costs and assessing the risk of uncertainty associated with partial or no ground treatment in less critical areas. Sufficient contingency costs were allocated should such risk eventuate.

The alliance used a managed, integrated process of design, construction control, monitoring, review and back analysis to design and construct the works, allowing the team to:

- Predict performance and factors of safety under the design loads and preloads
- Design and install instrumentation to capture movements at critical locations
- Carry out baseline predictions using actual ground conditions encountered at selected instrumentation locations
- Prepare in advance a course of action to be taken or modification of design if trigger levels are exceeded
- Monitor instrumentation at an appropriate frequency
- Perform visual inspections of the embankments and cuttings during construction for signs of distress
- Regularly review and back-analyse monitoring results to assess predictions and modify embankment and cutting construction if required, and to assess when to remove preload once the desired degree of consolidation was achieved.

Instrumentation and monitoring formed a key component of the works and was supplemented by regular visual inspection performed by the appropriately skilled site staff. Construction site staff understood the contribution of the instrumentation and monitoring process in the final outcome of the project, working around the instruments and providing immediate feedback on embankment performance.

The main section of the Ballina Bypass opened in November 2011, six months ahead of schedule, with minor works on the last two kilometres on the Bruxner Highway section completed in 2012.

- 19 bridges and three arches, including major structures over sensitive waterways
- 360 No. 60 tonne Super T girders landed for bridges using 500T crane on engineered platforms over extensive deep, soft soils
- More than two million cubic metres of earthworks (as much material below the ground has been treated, as material that has been shifted above the ground)
- More than one million tonnes of rock sourced from cuttings and crushed for re-use as quarry products on site greatly reducing truck transport from quarries on local roads ▶

grounds for success

The Ballina Bypass is the single most complex section of the Pacific Highway Upgrade, mostly due to the presence of the deep and extensive soil deposits, which vary greatly across the project and add to the complexity.

Coffey Geotechnics principal geotechnical engineer Richard Kelly said the soft soils along the Ballina bypass project were "not just deep," they were "some of the most compressible inorganic soils in Australia, if not the world."

The southern portion of the Ballina Bypass traverses over soft clays ranging between six metres and 28 metres deep between the Bruxner Highway and Cumbalum. The northern half of the project traverses rolling hills with some areas of soft clay. The soft clays were deposited about 10,000 years ago when the sea level rose to the level it is today, filling in deep valleys incised into the underlying older clays by the Richmond River and its tributaries.

Construction on soft ground is extremely challenging. Firm and stable access needs to be provided for heavy machinery, embankments need to remain stable during construction, and interaction between settling embankments and bridge structures needs to be managed. The risk of instability was particularly high at creek crossings where deep, soft soils occurred, together with the use of heavy cranes and drilling rigs for the construction of bridges and foundation piles.

Extensive and varied amounts of basalt floaters, between two and three metres in diameter, were present in the major cuttings, making bulk earthworks and cut to fill operations extremely difficult to manage on a daily basis. Materials needed to be excavated, processed, screened and crushed prior to usage. Equipment selection also needed to be constantly changed to the constant variability to the cutting materials encountered.

A range of ground treatment solutions were adopted to consolidate foundations and support embankments, including:

- Vacuum consolidation, an innovative soft soil improvement method used for the first time in Australia, to construct the road embankment adjacent to Emigrant Creek North

  Vacuum transmission pipes are installed into the soft soil and the site is covered with an airtight membrane. A vacuum is then created underneath by using a vacuum pump. The method preloads the soil by reducing the pore pressure and enables further surcharge fill to be placed rapidly to improve the ground while maintaining stability. Vacuum consolidation is faster and presents less stability concerns than conventional preloading. It is also cheaper than alternative methods for deep, soft soil sites.

- Dry soil mixing at bridge approaches, where embankment heights were less than six metres and depth of soft clay was less than 15 metres

- Dry soil mixing was also used in transition areas to provide the smooth ride, as well as in conjunction with wick drains in very deep, soft soil areas where time was available as a cost effective solution

- Vibro-replacement stone columns

- Dynamic replacement stone columns used for rapid ground improvement in shallow soils

- Surcharge fill material placed on top of prefabricated vertical drains (wicks) installed in the soft clays

- Light weight bottom ash fill as part of the design to reduce embankment weight and post construction settlements.

- 4.5 kilometres of treated soft soils
- Processed and crushed 2,000 tonnes of concrete and reused as engineering material
- Relocation of mangrove ferns at Emigrant Creek to minimise impact on riparian areas
- Installed nine permanent basins to assist with water quality improvement and spill control in the event of a traffic incident
- 150,000 cubic metres of concrete
- 256,000 cubic metres of concrete pavement

Richard Kelly has worked as a consulting geotechnical and structural engineer and has completed postgraduate studies and postdoctoral studies in geotechnical engineering.

Since 2005 Richard has been extensively involved in design and construction of the Ballina Bypass. As geotechnical manager, Richard is responsible for geotechnical engineering and laboratory testing, including geotechnical design, construction stage advice, back analysis for hold point release, instrumentation, monitoring and early warning systems. He is also responsible for the site earthworks, materials and concrete testing laboratory.

Richard has completed a PhD at Sydney University and post-doctoral research at Oxford University. He has also worked as a structural engineer in London and Sydney.

Dr Richard Kelly
+61 2 9911 1000
richard_kelly@coffey.com

- 30,000 cubic metres of chert pavement
- 14 kilometres of drainage pipes
- 650 reinforced box culverts
- 16 kilometres of guard rail/fencing
- 350 mature trees and 31,000 seedling trees planted, including 27,000 groundcover plantings
- 450 site personnel on project during peak construction with 70% of the workforce sourced from the local area
- During the 3.5-year construction period more than 4,000 personnel including subcontractors worked on the project.

IN THIS MINING FEATURE, COFFEY ENVIRONMENTS' RON D'ERCOLE PROVIDES AN UPDATE ON NEW WESTERN AUSTRALIAN LEGISLATION, SHARES THE LEARNINGS FROM THE STATE'S FIRST CONTAMINATED SITE AUDIT FOR A MINE CLOSURE AND EXPLAINS WHY THE BENEFITS OF ADDRESSING MINE CLOSURE EARLIER IN THE LIFECYCLE GO FAR BEYOND MERELY COMPLIANCE.

Mining Environment Now Begins at the End

Page 7 of 8

Legislative Update

A comprehensive mine closure plan is now a precondition of a mining lease being granted in Western Australia.

Coffey Environments' Ron D'Ercole said amendments to Western Australia's Mining Act 1978 now required a mine closure plan to be submitted to the Department of Mines and Petroleum for approval at the time of making a mining proposal application.

"The legislative changes ensure there is a planning process in place for the mine's closure, decommissioning and rehabilitation prior to commencement of mining," he explains.

Mine closure plans are required to be reviewed and approved by the department every three years.

Mining projects are also subject to the provisions of the Contaminated Sites Act 2003 and Contaminated Sites Regulations 2006, which mean contamination issues must be fully addressed in the closure plan and endorsed by Western Australia's Department of Environment and Conservation as part of the approval process.

Where a proposal is subject to a formal environmental impact assessment under the Environmental Protection Act 1986, the mine closure plan must also be submitted as part of the environmental impact assessment documentation.

"The amendment impacts not only new mining proposal applications, but also previously approved mining proposals and existing mining operations," he added.

> **"A mine closure plan is required to identify post-mining land use options and set out site-specific closure objectives..."**

For existing mining operations, mine closure plans and rehabilitation plans are required to be reviewed and submitted to the department by June 2014.

Mine closure plans are to be prepared in accordance with the Guidelines for Preparing Mine Closure Plans 2011, which has been jointly developed by the Government of Western Australia's Department of Mines and Petroleum and the Environmental Protection Authority.

"A mine closure plan needs to demonstrate, based on reliable science-based and appropriate site-specific information, that ecologically sustainable closure can be achieved," the guidelines outline.

A mine closure plan is required to identify post-mining land use options and set out site-specific closure objectives that are consistent with those land use options. It must also include completion criteria, to provide the basis on which successful rehabilitation and mine closure is determined.

Sufficient work is to be undertaken "to ensure that all key environmental issues and workable management mechanisms relevant to mine closure are identified, including hazardous materials, hazardous and unsafe facilities, contaminated sites, acid and metalliferous drainage, radioactivity, fibrous minerals and metal residues in mine wastes," the guidelines state.

"When assessing closure issues, the potential for contamination over the life of the mine needs to be considered so that the contamination can be removed, treated, contained or managed to meet the purposes of the agreed post-mining land use(s) and where practical, to maximise the beneficial use(s) of the land after mining."

Early Focus Benefits Business

The benefits of addressing mine closure earlier in the lifecycle go far beyond compliance with legislative requirements.

"A poor scientific approach and lack of rigorous data collection to contamination throughout the mine's lifecycle is likely to provide a lower level of certainty at the end of the mine life and result in considerable additional time delays and costs in achieving mine closure.

"This can delay contaminated site classification from being obtained and require ongoing responsibility for the contamination legacy of the mine site. Identifying and bridging data gaps in the early stages can result in significant efficiencies and positive outcomes, with lower costs to the mine operator and the relinquishment of the mine's security/bond.

"Expert contaminated land advice throughout the planning and operations of a mine can also lead to considerably lower investigation and remediation costs at the end of mine's life. The importance of this to a company cannot be underscored enough, as costly remediation occurs at a time when the mine is no longer generating revenue and for which a mine's bond does not necessarily cover," Ron noted.

Coffey Environments has over 400 specialist environmental consultants and a highly skilled team of contaminated land experts in Australia with auditors accredited in various jurisdictions:

- Four in Western Australia
- Six in Victoria
- Three in New South Wales
- Four in South Australia.

First Contaminated SITES AUDIT

Western Australian accredited contaminated site auditor Ron D'Ercole recently conducted the state's first contaminated site audit for the closure of a mine under the new legislative regime.

"Mine closure plans have historically focused on rehabilitation and revegetation. However, with the introduction of mine closure guidelines, closure strategies need to specifically address investigation and remediation of site contamination.

"Due to the infrequency of mine closures, as opposed to care and maintenance, there has been little precedence in relation to mine closures and conformance with the Contaminated Sites Act 2003.

"This makes the learnings from the first audit so valuable to the industry. It has given it a greater understanding about how the Contaminated Sites Act 2003 applies and the requirements for future mine closure planning," he explained.

Ron said the audit reinforced the need for closure actions to be undertaken and documentation to be produced specifically to address contaminated site issues. It highlighted the need for mine operators to:

Mine Commencement

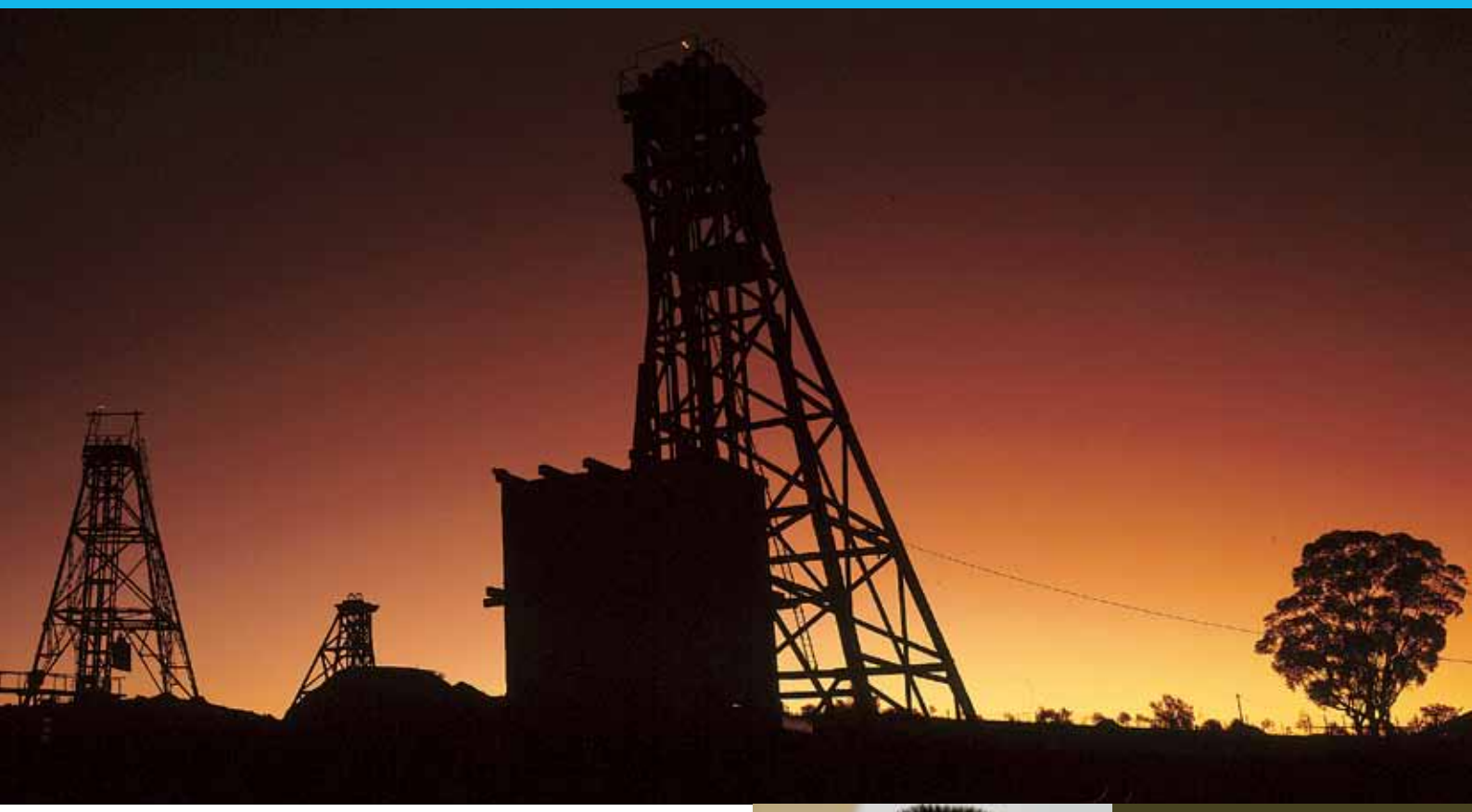
- Develop a clear understanding of the site's environmental setting, including topography, geology, hydrogeology and drainage conditions
- Establish naturally occurring background concentrations (ie, baseline) at the beginning of the mine's life, particularly important as mining activities are characteristically associated to highly mineralised areas
- Design the mining footprint and consequential environmental impacts to be as minimal as possible

Mine Operation

- Collect sufficient data to develop a conceptual site model that can provide a robust scientifically rigorous review of the contamination source-pathway-receptor linkages to determine if the identified concentrations of chemicals of potential concern could present a risk of harm to human health, the environment or any environmental value
- Put in place the correct reporting mechanism specifically for contaminated site issues. Record all past and present potentially contaminating activities, including potential point and diffuse contaminant sources. Document all relevant soil and groundwater investigations as well as remediation and waste management
- Characterise all mine waste for its contamination potential prior to its reuse (eg, crushed waste rock for roadbase)

Mine Closure

- Detail the areas of environmental concern for the site
- Review potential contaminants of potential concern (COPCs)
- Provide sufficient review of the site history encompassing activities that could lead to contamination prior to and post implementation of the rehabilitation plan
- Consider the final land use for the site (eg, pastoral use or grazing for native animals) and ensure appropriate remediation is completed
- Detail the process of remediation and where various wastes were disposed
- Conduct validation investigations to establish the quality of remaining soil post remediation and also the quality of the fill brought back to re-contour the site
- Justify where sample density is not in accordance with the minimum requirements in the Development of Sampling and Analysis Programs (DEP, 2001) guideline
- Confirm that all samples collected for analysis used appropriate techniques to provide accurate, representative and reproducible data
- Justify and detail the number, construction and placement of groundwater wells and whether that can suitably characterise groundwater quality and potential impacts over a large and potentially complex area (in terms of contaminant distributions)



- Clarify the risk associated with the closure of the open cut or underground mine and the cessation of dewatering with regard to flooding of the works and the potential for increased leaching of contaminants
- Provide a structured planning approach to developing sampling designs for data collection activities that will ultimately support the conclusions and recommendations
- Assess waste disposal areas, for example, the decommissioned tailings storage facility in terms of its long-term risk to human health and the environment, eg, the potential for human health risks if the tailings material is exposed and whether the tailings provide an ongoing source of impact to the groundwater
- Provide a review based on the Guidelines for the Assessment of On-site Containment of Contaminated Soil (ANZECC, 1999) and the future risk and management associated with the tailings storage facility or other hazardous waste facility
- Detail all community consultation.

The Department of Environment and Conservation will need to provide final sign-off or classification of the contaminated status of a site and its suitability for particular land use, as a requirement for the relinquishment of a mine's security/bond.

To assist the department's decision making, an accredited contaminated site auditor can undertake an independent review of contaminated site investigations and remediation undertaken at the site. However, there is no current mandatory trigger, in accordance with the Contaminated Sites Act 2003, to undertake an audit (ie, mandatory audit).

The auditor's consideration is based on whether the work is complete, accurate and compliant with relevant legislation, guidelines and policies.

Ron D'Ercole
+61 8 9355 7100
ron_dercole@coffey.com

Ron D'Ercole is a principal of Coffey Environments and has over 30 years of experience in geo-environmental consulting, contaminated site assessment, site remediation and environmental management. Ron is a Western Australia Department of Environment and Conservation Accredited Contaminated Sites Auditor.

As a qualified environmental chemist, Ron has considerable knowledge of terrestrial, aquatic and atmospheric chemistry. On top of this, he has gained extensive experience in fresh and marine waters, sediments and biota, groundwater and soil chemistry.

An MBA has complemented Ron's technical background, providing business skills and an insight into the operations in which he works.

Ron has been project director/manager and/or technical specialist for over 500 contamination assessment and remediation studies worldwide, covering a wide range for the mining, commercial/industrial and redevelopment sectors. Ron's strengths include environmental impact studies, facility audits, statutory compliance reviews, due diligence and environmental management assessment and system development to ISO 14001.

LEADING OCCUPATIONAL HEALTH AND SAFETY EXPERT PAUL FOLEY REMINDS EMPLOYERS THAT SUPPLYING PERSONAL PROTECTIVE EQUIPMENT (PPE) IS THE BEGINNING OF THE PROCESS, NOT THE END. IN THIS ARTICLE, HE EMPHASISES THE IMPORTANCE OF USING THE CORRECT PPE AND SHARES SOME PRACTICAL TIPS FOR CHOOSING AND USING THE CORRECT RESPIRATOR.

RESPECTING **RESPIRATORS**

Coffey Environments principal Paul Foley said two potential workplace incidents in Australia had provided a timely reminder about the importance of using the appropriate protective equipment to control workplace hazards.

"Both recent incidents involved an incorrect type of respirator being used. In one case, a person was using a mask primarily designed to filter organic vapours, not particles, during asbestos inspection works. In the other, a person doing contaminated land inspections was wearing a mask designed for protection against particles and not organic vapours."

Paul explained that it was only after identifying the type and level of the respiratory hazard, could suitable respiratory equipment be chosen. "It will then be the combination of the filter and mask style chosen that determines the protection provided."

The selection and performance of respirators in Australia is based on the Australian Standards AS/NZS1716 Respiratory Protective Devices. Regulators expect respirators used in Australian workplaces to meet the requirements of this standard.

AS/NZS1715 Selection, Use and Maintenance of Respiratory Protective Devices provides information to correctly use the appropriate respiratory protection system.

Essentially, there are two types of respirators – air supplied and filtered air. Special training is required for air supplied respirators, as they are often used in very dangerous environments such as confined spaces. In the case of filter masks, which do not create or supply oxygen, there are three main types – disposable, half face and full face.

"One filter mask is not better than the other – each has its own place. However, except for some specialised respirators, all rely on a good face fit or seal so that the contaminated air passes through the filter, not the side of the mask," Paul emphasised.

Facial hair is the most common cause of poor fit, although some people with finer or broader features can have difficulties achieving a good face fit, especially with disposable type masks.

A disposable mask and a half face mask of the same rating offer similar filter protection, but the half face mask comes in various sizes and often has better straps, making it more likely to fit more people. A disposable mask has the advantage of not requiring cleaning, maintenance and storage, but only comes in limited sizes (often one).

However, filter types vary markedly and are designed to filter one or two types of contaminants (see filter standards over leaf). Combination filters are available but have limitations in that they last a shorter time because they have multiple but often smaller filters.

"Overall, it is usually the mask style or face fit that limits the protection offered, not the filter efficiency. A common fallacy is that if you put a high efficiency filter, for example P3 rated, into a half face mask, then you will have a P3 rated protection. This is actually incorrect as it will still only be P2 rated because of the limiting factor of face fit," he said.

Paul stressed that organic vapour/acid mist filters offer some protection against particles, but particle filters offer no protection against gases.

Paul's tips for using the correct respirator:

- Know the contaminant you want protection from and use applicable filter
- Make sure the protection factor is sufficient for the level of contamination in the air – if in doubt, measure the air
- Ensure the mask fits and remains correctly fitted
- Keep the mask maintained
- Accept that one mask will not suit all situations

> **... Ongoing training, communication and monitoring is required if the role of PPE is to be successful.**

- Remember inhalation is one route of entry into the body and that ingestion and skin absorption may also occur and the task may require appropriate procedures and other PPE

- If unsure ask expert advice from an occupational hygienist, or the respirator manufacturer.

As an experienced occupational hygienist, Paul works closely with clients to identify and solve their workplace health and safety problems.

“In the hierarchy of controls for preventing work-related injury or illness, we often see PPE as an important part of an integrated approach that includes elimination, substitution, engineering and administration.

“The role of PPE is to supplement other means of hazard control, further minimising the risk of injury. However, ongoing training, communication and monitoring is required if the role of PPE is to be successful,” Paul concluded.

AUSTRALIAN STANDARDS - FILTER MASKS

Under AS/NZS1716, filters used in respirators are required to meet certain performance levels to achieve a classification. This then allows determination of its suitability for use against specific contaminants at various concentrations as explained in AS/NZS 1715.

Filters are tested for capture efficiency in the laboratory using a salt aerosol challenge agent. Under specified test conditions, the amount of these particles that break through the filter is measured, which allows classification of the filter.

Under the standard, there are three classes of particle filters:

P1 — for mechanically generated particles, eg, dusts, flour, silica

These are suitable for the relatively large particles (>1 micron) released in mechanical operations like sanding, drilling, cutting, sawing, crushing etc.

P2 — for mechanically and thermally generated particles, eg, welding fume

This class of filters has a higher capture efficiency to be able to deal effectively with smaller, thermally generated particles like sub micron sized welding fume. The P2 is also the class of filter recommended for specific infection control applications, where biologically active airborne particles and aerosols can be captured under specified conditions.

Class P3 respirators — for use against all particles including highly toxic materials

This class of filter is used with toxic materials and/or when very high protection levels are needed, eg, beryllium, radioactive particles.

Other filter types or types of respirators are to be considered for protection against gases and vapours and can be quite complex and therefore expert advice is often required, especially if multiple contaminants are present.

POTENTIAL WORKPLACE CONTAMINANTS

Airborne contaminants that may be present in a workplace include:

Nuisance dusts: Small particles such as road dust and dirt at high concentrations can clog up the lung's airways and create discomfort and breathing difficulty

Toxic dusts: After being inhaled into the lungs, toxic particles, eg, asbestos and silica, can cause local or remote effects to the body

Irritant gases: Water-soluble gases, such as ammonia, can cause irritation to the upper respiratory tract

Asphyxiants: Gases can interfere with the supply of oxygen to the body. An inert gas, like nitrogen, can dilute the oxygen in the air to a dangerously low level. Chemical asphyxiants, like carbon monoxide or hydrogen cyanide, are taken up into the bloodstream in preference to oxygen and cause the body's organs to shut down

Anaesthetics: Organic solvents are readily absorbed from the lungs into the bloodstream and then carried around the body. Damage can occur to the brain and the liver, as well as depressing the central nervous system, causing paralysis and death. Examples include petrol, ethanol and benzene

Sensitisers: Isocyanates and some timbers can cause allergic asthma-type reactions after exposure

Paul Foley
+61 8 9355 7100
paul_foley@coffey.com

Paul has extensive experience in the development of Occupational Health and Safety management systems and procedures.

He has developed and delivered numerous training packages on a range of occupational hygiene topics, including manual handling, noise and vibration, asbestos, mercury, confined space measurement, sulphur dioxide, nickel and silica.

A published author and highly regarded technical advisor, Paul's expertise and knowledge has been used in the Australian court system, the Industrial Relations Commission and on numerous health and safety committees.

TALKING MINE RE-ENTRY

Dr Jessie Davey
+61 3 9473 1300
jessie_davey@coffey.com

After spending last week inspecting a mine site failure in southern Australia, Coffey Mining's Jessie Davey is back in her Melbourne office and takes a few minutes to chat with *Infusion* about her specialist work in mine site re-entry.

Jessie is a structural geologist who specialises in geotechnical engineering. Her expertise includes high resolution regional and local structural geology interpretations; the construction of high resolution 2D and 3D structural and stability models; neotectonic and active tectonic deformation and stress measurements; and the design, implementation, monitoring and interpretation of micro-seismic networks for natural and artificial seismic responses.

She has worked on major projects throughout Australia, as well as in Pakistan, Afghanistan, Indonesia and Papua New Guinea.

Infusion: Tell us about the mine entry services you provide clients?
Jessie: I am part of a specialist team within Coffey Mining that provides clients with mine closure and re-entry services for pits, tailings facilities and quarry walls. Our role is to secure failures at a mine site when they occur. We also develop new mining processes to help clients achieve better financial and safety outcomes for the mine over the long term.

Infusion: Why has the team had such a high success rate in rehabilitating mine failures?
Jessie: We take a multi-disciplinary approach, with the team having a specialist understanding of mining, geology, structures, and hydrology.

Infusion: What makes your approach different?
Jessie: We provide an engineering solution that takes into account the geology and the mining practice. In this sense, we analyse from a regional to a local level and take into account the mining practices and requirements of the mine. This provides us with a much deeper understanding of the problem, the potential causes, and what we need to do to secure the mine.

Infusion: What type of studies do you undertake to achieve this understanding?
Jessie: A whole range of studies feed into our decision making, including numerical modelling to predict behaviour of the earth, testing of physical properties and rocks, mapping of structures and lithology, and groundwater modelling.

Infusion: Can you tell us about your recent analysis of a failed pit wall?
Jessie: We were called in to provide scenario-based modelling of the failure to emulate the conditions of a mine that had undergone transitional failure in a pit wall that was 100 metres high. For this project, our objective was to establish cause; and to provide solutions as to how to manage the failure to allow future mining to continue. Our conclusion was that the transitional failure occurred as a result of unloading the slope's toe and hydrostatic pressure imbalance.

Infusion: You were recently commissioned to conduct a structural analysis of a wall to determine best practice management and design for future mining at the site. What work did you undertake and what were your recommendations?
Jessie: This was a difficult assessment as the wall being modelled was in the process of failing as a result of a hydrostatic pressure build up. As well as this, folding within the rock meant that, in places, the wall had been cut too steep, which exposed bedding angles that were steeper than the rocks natural friction angle. This was creating localised block failures as slipping was also occurring along bedding plains. Recent work at the mine had indicated that the line of load continued underneath the failing wall, so it was imperative that we found a workable solution for the mine.

We conducted a two-day on-site review, which included measurements and observations of structures, measurements of bedding orientations, wall inspections, and assessment of instrumentation results. Geotechnical lab testing was also conducted to help stimulate the friction angle of the rock, and we reviewed existing pit designs.

Based on our studies, we were able to recommend a cut back profile with blasting recommendations that allowed for recovery of the ore and maintained safety along the wall.







WANTED. EXTRAORDINARY PEOPLE.

Would you like to use your professional skills to help solve some the world's most difficult challenges? Our specialists work in geosciences, international development, and project management.

As a specialist professional services consultancy, we like to set the benchmark for technical excellence. With more than 50 years of experience, Coffey is well known in our markets for deep technical skills and market-leading solutions to complex tasks. Our team of 4,000 specialists is working around the world in more than 80 countries, delivering extraordinary outcomes for our clients while working on some of the most interesting, challenging and rewarding national and international projects.

We are committed to developing great people, great careers and the next generation of great leaders in technical mastery.

So if you are committed to an extraordinary career in technical consulting excellence, visit coffey.com and take a look at the world of opportunities we offer.

Coffey is listed on the Australian Securities Exchange (ASX:COF).

COFFEY INTERNATIONAL LTD

Please visit **coffey.com** for more information about the Coffey group.

INFUSION

If you have suggestions, would like to contribute or receive INFUSION electronically, please email **contactus@coffey.com**.

coffey SPECIALIST KNOWLEDGE EXTRAORDINARY OUTCOMES

coffey.com